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GERMAN Iron and Steel Position

Before the present war, Germany normally relied heavily upon imports of iron ore. Out of a total supply of 12.7 million tons of metal content in ores available to Germany in 1937, 26 percent was from enemy countries and, therefore, immediately cut off by the outbreak of hostilities; 51 percent was from neutrals and, therefore, endangered by further moves of the Allies and the blockade. Only 23 percent remained assured to Germany, herself.

Ore, however, constituted only 60 percent of German total metal supply. Scrap, both from fabricating processes and from old metal, is also important raw material in steel production. In terms of total metal from both ore and scrap, 24 percent of the supply was immediately cut off, 41 percent endangered, and only 35 percent remained assured to Germany herself.

Under these circumstances, Germany was faced with the dilemma of newly expanded steel requirements and a raw material supply already reduced and threatened with further reductions. Germany solved this problem principally by conquest, and, to a lesser degree, by an increased ore output in France. At present about 46 percent of the metal content of Axis European ore supply comes from France and 18 percent from other conquered countries. Sweden supplies another 18 percent, while the Old Reich supplies only 15 percent.

The steel making capacity of Axis Europe is far above the present production rate. About 44 to 48 million tons of steel ingots and castings are being produced in 1942, but capacity is closer to 56 million tons. Over 40 percent of this capacity is in the form of Bessemer converters, which produce steel less desirable than that from Open Hearth or electric furnaces. Consequently, much of the unused capacity is in the Bessemer converters, while there is heavy pressure on the utilization of Open Hearth and electric furnaces. This pressure is partially relieved by the use of the Duplex process whereby a batch of steel is started in a Bessemer converter and finished in an Open Hearth furnace. Apart, then, from the limited Open Hearth and electric furnace capacity, there is not a general limit imposed upon steel production by productive facilities.

General limitations of manpower both for the production of steel and for the fabrication of finished products account for an Axis steel production lower than capacity. Direct military consumption requires only about 40 percent of the total steel supply. Reports have been received of the utilization of steel for projects of a long-run nature which may not be expected to contribute to the war effort in the near future. These reports, if true, constitute final evidence that steel is not a bottle-neck in the German military effort.

Tables 1 and 2 show the 1937 and 1942 output of iron and steel in Axis Europe.

TABLE I

Analysis of the Relationship Between the European Production of Iron and Steel and the Supply of the Raw Materials (1937) (million metric tons).

		Germany and Saar	Austria	Czechoslovakia	Greater Germany	Poland	France	Belgium and Luxemburg	Italy	Sweden	Other Europe and N. Africa	TOTAL
1. Production of Ore	A	8.5	1.9	1.8	12.2	.8	37.4	7.9	1.0	15.2	11.0	85.5
	B	2.8	.7	.6	4/1	.2	11.5	2.2	.5	9.1	5.7	33.3
2. Export of Ore	A	....	.7	.2	.9	...	19.3	2.4	...	14.0	5.0	41.6
	B	....	.3	.1	.4	...	6.8	.8	...	8.5	2.6	19.1
to Axis Area 1/	A	....	.7	.2	.9	...	18.9	1.9	...	12.3	2.6	38.6
	B	....	.3	.1	.4	...	6.6	.6	...	7.5	1.4	16.5
Outside Axis	A	....	...	.....	....	...	.4	.5	...	1.7	2.4	5.0
	B	....	...	...	....	...	.2	.2	...	1.0	1.2	2.6
3. Imports of Ore	A	19.8	...	1.5	21.3	..5	.9	12.4	.2	....	....	35.3
	B	9.9	...	.5	10.4	.3	.5	4.5	.1	....	....	15.8
From Axis Area	A	19.0	...	1.3	20.3	.4	.9	12.4	.2	....	....	34.2
	B	9.5	...	.4	9.9	.2	.5	4.5	.1	....	....	15.2
From Outside Axis	A	.8	...	.2	1.0	.1	....	....	...	....	....	1.1
	B	.4	...	.1	.5	.1	....	....	...	....	....	.6
4. Supply of Ore (1-243)	A	28.3	1.2	3.1	32.6	1.2	19.0	17.9	1.2	1.2	6.0	79.2
	B	12.7	.4	1.0	14.1	.5	5.2	5.9	.6	.6	3.1	30.0
5. Coke Requirements		16.0	.4	1.7	18.1	.6	8.2	7.5	.6	.5	1.8	37.3
6. Available Coke		39.2	1.1	2.4	42.7	1.7	12.1	7.4	2.4	2.7	3.3	74.3
7. Pig Iron Products		16.0	.4	1.7	18.1	.7	7.9	6.3	.9	.7	1.2	35.8
8. Scrap Imput		9.8	.3	1.1	11.2	1.1	3.6	1.5	1.8	.7	.9	20.8
9. Metal Supply (4-8)		24.6 2/	.7	2.1	27.4	1.6	8.8	7.3	2.4	1.3	4.0	52.8
10. Foundry Products		3.1	.1	.3	3.5	.2	1. 3	.9	.3	.2	.5	6.9
11. Metal Supply Available for Steel (9-10)		21.5	.6	1.8	23.9	1.4	7.5	6.2	2.1	1.1	3.5	45.7
12. Steel Plant Loss (10% of 11)		2.2	.1	.2	2.5	.1	.7	.6	.2	.1	.4	4.6
13. Steel Ingots and Castings as estimated from ore, scrap, etc.		19.3	.5	1.6	21.4	1.3	6.8	5.6	1.9	1.0	3.1	41.1
14. Reported Steel Ingots and Castings		19.5	.6	2.3	22.4	1.6	7.8	6.3	2.1	1.0	1.6	42.6

A-Ore
b-Metal content of ore

1/ Axis Area-Area controlled by Axis in 1942

2/ Includes other blast furnace charge

Sources and Methods: See Appendix

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TABLE II

Analysis of the Relationship Between the European Production of Iron and Steel and the Supply of Raw Materials, 1942, (million metric tons).

		Germany and Saar	Austria	Czechoslovakia	Greater Germany	Poland	France 66	Belgium and Luxemburg	Italy	Remining Europe	Axis Europe	Sweden	Other Europe & N. Africa	Axis-Controlled Area
1. Production of Ore	A	18.0	6.0	1.8	25.8	.9	44.0	6.0	1.0	2.2	79.9	10.7	1.1	91.7
	B	5.0	2.1	.6	7.7	.3	15.0	1.8	.5	1.1	26.4	6.5	.5	33.4
2. Export of Ore to Axis	B	....	.9	...	.9	...	10.5	...	...	.2	11.6	5.7	.5	17.8
3. Imports of Ore from Axis	B	14.5	...	1.1	15.6	.4	....	.4	.8	...	17.2	....	...	17.2
4. Supply of Ore	B	19.5	1.2	1.7	22.4	.7	4.5	2.2	1.3	.9	32.0	.8	...	32.8
5. Coke Requirements		23.2	1.5	2.1	26.8	.8	5.8	3.1	1.6	1.1	39.2	1.0	...	40.2
6. Available Coke		49.5	1.8	3.5	54.8	1.8	6.3	4.8	3.3	3.8	74.8	1.9	...	....
7. Pig Iron Products		23.3	1.4	2.0	26.7	.8	5.4	2.6	1.6	1.1	38.2	.9	...	....
8. Scrap (Low estimate)		14.9	1.1	1.7	17.7	1.3	2.4	1.2	1.5	.8	24.9	.4	...	....
9. Metal Supply		34.4	2.3	3.4	40.1	2.0	6.9	3,4	2.8	1.7	56.9	1.2	...	....
10. Foundry Products		4.8	.3	.5	5.6	.3	1.0	.5	.4	.2	8.0	.1	...	....
11. Metal Supply available for steel		29.6	2.0	2.9	34.5	1.7	5.9	2.9	2.4	1.5	48.9	1.1	...	....
12. Steel Plan Loss (10% of 11)		3.0	.2	.3	3.5	.2	.6	.3	.2	.1	4.9	.1	...	....
13. Steel Ingots and castings		26.6	1.8	2.6	31. 0	1.5	5.3	2.6	2.2	1.4	44.0	1.0	...	....
14. Steel Ingots and castings according to allowance for possible additional scrap, sinter, slag, and pyrites		....	...	...	....	...	...	...	...	...	48.9	...	...	....
15. Steel capacity		27.0	2.0	3.0	32.0	2.0	10.0	7.5	2.5	2.0	56.0	...	...	....

A-- Ore; B-- Metal Content of Ore

Germany's ability to marshall the iron and steel capacities of Europe depends upon: a) the available supply of ore, b) scrap supplies, c) the supplies of coke d) the extent of facilities for processing these raw materials -- blast furnaces, convertors, rolling mills, and fabricating plants -- and e) man power. These are considered in turn.

I. General Patterns

In Table 1, the pattern of iron and steel production for 1937 is given. Steel ingots and castings are there estimated from ore, scrap, foundry products with allowance for steel plant loss. The estimates are not quite equal to the amount of steel ingots and castings directly reported in published in published sources. There are several factors explaining this. In the first place, the changes in stocks at various stages of production are not known, and the metal content of ore exported from a country may be quite different from the average metal content of ore used in that country. Steel plant loss is merely an average and will vary from region to region. Scrap data may not be accurate, the amount of pyrites, slag, and sinter are ignored 1/. Finally no published data on foundry products are available except for Germany and the estimates for other counties are subject to error.

1/ Except in the case of Germany (Altreich).

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Despite these shortcomings, agreement is quite close so that the pattern we have derived from the various sources seems to be correct in general outline. The data for "Other Europe" are the least accurate of any of our figures, the original data here were quite unreliable. A large part of the error in the other figures comes from the lack of knowledge about blast furnace charge. In all probability, there was some slag, sinter, or pyrites charged into the furnaces of countries besides Germany, but this has not been taken into account 1/.

In Table 2, the same elements are considered for 1942 as were considered in Table 1 for 1937. All the flaws which existed in the attempt to present the 1937 pattern, naturally are present here in even greater degree. However, the fact that the process of estimating steel by the component parts was not too far afield for the 1937 data gives some excuse for attempting the same method.

II. Specific elements in iron and steel production

A. Iron ore, 1937 and 1942

1. Greater Germany is estimated as now producing 1/ 7.7 million tons metal content of ore as against 4.1 in 1937. The increase has occurred in Germany proper (2.8 to 5.0) and in Austria (.7 to 2.1). Czechoslovakia's production (.6) is not considered as having changed. In large measure, German

1/ The production of iron pyrites in Europe was 6.1 million metric tons in 1937. This contained about 2.3 million tons of iron. According to Hermberg's "Industrial Capacity of Europe," Appendix II, p.2, Germany introduced .8 million tons of iron in the form of calcined pyrites into blast furnaces, where or if the 1.5 million tons were used is not known.

and Austrian expansion has been due to the Herman Goering Works and the utilization of low grade Styrian and Selzgitter ores which run 28 to to 30 percent iron. The significance of the Herman Goering Works, However, must not be over emphasized. Two things are important. In the first place, the Herman Goering Works are not a totally new contribution to German capacity; it embraces in its system many older plants. Secondly, there are recent reports that the exploitation of low grade ores is not as successful and economical as had been hoped, so that the Goering Works are not even now operating at anything like capacity. It is reported that production has reached only 25 to 50 percent of the original program because of difficulties of operation.

2. The British estimate that France produced ore at 15 million tons of metal content in 1942. The basis of this estimate is not disclosed. Certainly the potential of the French mines is as great as this. However, the volume of ore mined would need to be 44 million tons against 37 in 1929 which yielded 17.6 million tons of metal content. At present, France is providing about 46 percent of metal content of Europe's ore supply. A large portion (2/3) of this production is exported, and French blast furnaces consume only 4.5 tons of metal content.

3. Ore shipments from Sweden have decreased. It is difficult to know whether this is due to increased continental mining or whether the increased continental mining is due to limitation of Swedish shipments. In any event,it is quite probable that there have been shipping difficulties, and

Sweden has been restricting iron ore shipments when German trade agreements are not fulfilled.

4. Belgium and Luxemburg, Poland, and Italy contribute only 8 percent of the continent's ore (metal content) supply. There has been no great activity or increase in ore output in these countries. In fact, Belgium and Luxemburg output has declined from 2.2 to 1.8 million, and Italian output (.5) has not changed. There has been some increase of ore mined in Poland (.2 to .3 million tons metal content).

5. Although "Remaining Europe" produced 2.1 million tons of metal in 1937, the British consider that only 1.6 millions will be available to German Europe.

6. Reports from North Africa indicate that monthly shipments are quite small. Probably, the metal content does not exceed 200,000 tons annually 2/. However, the potential output (metal content) is almost 2.5 million. Shipping difficulties prevent Axis Europe from realizing this potential under present conditions.

The total 1942 supply of ore to Axis Europe is estimated at 94.2 million tons containing 32.6 million tons of metal. This represents an increase of 2.6 million tons in metal content over 1937, in spite of decline of the use of Swedish ore by 2.8 million tons.

1/ British figures for 1942 are given in MEW, "The Enemy Iron and Steel Position," June 12, 1942

2/ State Department source.

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B. The Scrap Supply, 1927 and 1942

There are three major sources of scrap in an economy. Rolling mills create scrap in producing rough stock, and further fabrication of this rough stock creates more scrap. The dismantling or discarding of machinery and equipment also yields a certain amount of "old scrap." Detailed information on scrap supply is not available for several reasons. For a large part, rolling mills produce scrap which goes right back into steel making. Thus, it never leaves the scene of operations. It can be considered as circulating metal and if production were at one continuous level, it could be ignored, since the loss from rolling mills would be equal to the scrap they yielded. However, in making a scrap estimate, Hermberg has assumed that rolling mill scrap is about 21 percent of total production 1/. Fabrication processing scrap comes to about 12 percent of total steel production. In other words, in the pre-war period processing scrap was equal to about one third of total steel production. Old scrap naturally is not a function of steel output. Between 1933 and 1937, old scrap was between 3.8 and 6.3 million tons, and imported scrap was .05 to 1.2. From the Above information, the following may be deduced:

1/ Op. cit. Appendix 3, various percentages were used for different countries.

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Estimated 1937 scrap position (million metric tons)

8.8	rolling mill scrap
4.9	Process
5.9	old scrap
1.2	imports
20.8	total scrap

In wartime, the percentage of process scrap increases because of the nature of output. Consumption estimates by individual items indicates that at least 18.5 million tons of process scrap is available to Axis Europe 1/, and later estimates have revised this figure to 20. million. Further more, old scrap probably has not decreased although imports have fallen off. Battlefield and bomb damage scrap are new contributors in this field and probably more than compensate for those sources which have declined. The total 1942 scrap figure is therefore estimated to be about 25 to 28 million (higher limit including some from slag and pyrites), making a total metal supply of 57 to 60 million. The data below was based on the lower limit.

C. Coke Situation

It is frequently asserted that, because the current supplies of ore to the Continent are of lower grade than

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1/ MEW "Estimates of Axis Europe Steel Requirements"

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previously used, an inordinate demand is being made on the coke supply, straining coking facilities, to examine the relevance of the composition of the ore supply to the coke available for consumption in the several countries, there is presented in Tables 1 and 2 for 1937 and 1942 the metal supply related to the coke necessary for its use. It will be seen that in 1942 an adequate amount of "available coke" is allotted by the British to cover the metallurgical needs of every country, thus indicating the consistency of the British position. However, for France, and Luxemburg, and Belgium the coke supply is seen to have dwindled from 21.5 million tons in 1937 to 10.1 in 1942. Corresponding to the drop in coke supply of 11.4 millions is a decline in pig iron output of 6.2 million metric tons requiring 6.8 million tons less coke. This fits in with the picture the British give of French, Belgian and Luxemburg iron and steel works languishing for want of coke. Undoubtedly coke is one of the weaker elements in the Axis iron and steel position, yet total coke requirements have not increased greatly (37.3 to 39.2) and total coke available has increased from 68.2 to 74.8. Coke, then, should not prove to be a serous bottleneck in iron and steel production.

D. Iron and Steel Capacity

Iron and steel capacity in Europe has been estimated by various sources from 50 to 65 million tons. In all probability, the true figure is around 55 million distributed as follows:

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Germany	27.0 million tons
Austria	2.0
France	10.0
Belgium & Luxemburg	7.5
Poland	2.0
Czechoslovakia	3.0
Italy	2.5
Remaining Europe	2.0
Total	56.0 Million tons.

Germany and Italy are probably pressing on capacity, whereas France, Belgium and Luxemburg operate at about 45 percent of capacity. Whatever figures are accepted, it is evident that plant capacity in general is not a limiting factor, although it may well be that capacity of certain specialized kinds of plants, such as electric furnaces or facilities for making plate, may restrict the output below a level desirable from the German point of view. Bessemer converter output is not so desirable for the production of the specialized steels used in armaments as are the products of open hearth and electric furnaces. The steel plants of France, Belgium and Luxemburg are principally of the Bessemer type, hence it is reasonable for the Germans to discourage their operation and to encourage the migration of workers and the shipment of ore and coke to Germany and Italy where better facilities exist 1/.

1/ Cf. MEW: Intelligence Weekly, March 8, 1942.

E. Labor

If the present efficiency of labor in the iron and steel industry were equal to that in 1937, one skilled, two semi-skilled and one unskilled workers could smelt, process and mill, on the average, 320 tons of steel annually. In other words, the amount of steel produced is large relative to manpower used. If manpower is scarce enough to cause a bottleneck in steel production, probably there would be an even greater shortage of manpower in the steel consuming industries. In other words, lack of an adequate labor supply will probably restrict the consumption of iron and steel rather than its production.

APPENDIX--SOURCES AND METHODS

Notes to Table 1:

1. Production of Ore
2. Exports of Ore
3. Imports of Ore
4. The Supply of Ore

Several sources have been used: The British Iron and Steel Institute Statistics of the Iron and Steel Industry for 1937, Statistiches Jahrbuch, 1937, the League of Nations Statistical Year Book, and Hermberg's paper, Europe's Industrial Capacity: Iron and Steel. The last contains a bibliograph of sources.

Metal contents of exports and imports have been computed

from figures on the movement of ore, and it was necessary to assume that the ores which moved were of higher grade than the average of the ores produced by a particular country. The estimates of metal supply are, therefore, not exact.

5. The coke requirements of various ores have been obtained from W.W. Trinks, Mr. Vreeland, and the Statistiches Jahrbuch. Since the exact pattern of exports and imports is only a matter of conjecture, the arraying of ores by coke requirement is based on some assumptions as to the nature of the ore trade. The Swedish imports into Germany are know, as are French imports, and this gave some clue as to the proper disposition of the various kinds of ores. Following is the allocation of ores by coke requirements:

80% - Swedish ores; scrap introduced into the blast furnaces was also included in this category.

100%- All ores about which nothing specific was known. This includes Italian ores, "Remaining European" ores and imports from outside the continent.

115% - Minette ores, French and German

130% - Polish ores and those from Belgium and Luxemburg. This has been inferred from their low metal content.

150% - Salzgitter and Styrian Mountain ores which are of very low metal content.

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6. Available coke here is the same as apparent consumption. This is given by the British in the MEW report on coal of June 8, 1942.

7. Pig iron production is given by Minerals Year Book, 1940, and others.

8. Scrap estimates have been built up by Hermberg. His estimates assume different rolling mill losses and fabrication scrap in the various countries. These figures, together with data an old scrap and imports, give total scrap consumption, whether introduced into blast furnaces, steel plants, or foundries.

9. Metal content of ore plus scrap in all cases except Germany. Pyrites, sinter, and slag should be taken into account, but sufficient information is lacking, except in the case of Germany. Hermberg op. cit. (Appendix II) gives blast furnace charge for Germany, 1937.

German Blast Furnace Charge	
Total Iron Ore	81.3
Slag (sinter,(etc.	8.2
Calcined Pyrites	5.5
Scrap	5.0
	100.0

This general pattern cannot be assumed for countries other than Germany. The relative difference between iron supply and pig iron product is much greater in Germany than most continental countries. This is probably due to less extreme use of sinter slag and pyrites outside of Germany.

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10. Foundry products as given for Germany in Statistiches Jahrbuch, 1937. No figures are available for other countries, so the same relation was assumed between steel and foundry products in other countries as existed in Germany.

11. Metal supply minus foundry products.

12. Steel plant loss is taken at 10% in view of the size of the convertors and open hearth furnaces. This figure does not include any steel mill loss.

13. Final estimates of steel ingots and castings as indicated by above data.

14. As reported in Metal Statistics, 1942.

Notes to Table II

1. Production of Ore

Figures given are the MEW estimates presented in "Enemy Iron and Steel Position" report of June 12, 1942.

2. Export of Ore

3. Import of Ore

From the supply of ore as given in 9) and the production of ore in 1) it was possible by subtraction to determine the net import or export which the British assigned each country.

4. Supply of ore has been taken equal to the British statement of the production of pig iron (MEW, op, cit.). It will be noted that this is .6 tons less than total ore production.

5. Coke requirements were estimated from ore supply and pig iron produced. The difference between ore supply and pig iron was considered as requiring a weight of coke equal to its own weight, i.e., ton for ton. For the most part, this is probably true, as a part of this is scrap which is introduced into blast furnace and the remainder is slag sinter and pyrites. The former requires less than a ton of coke per ton smelted and the latter more.

6. Available coke again is the same as apparent consumption and is given by the British in their study of "The Coal Situation," June 8, 1942. Data for Austria and Luxemburg have been estimated.

7. It was assumed that the prewar relation of ore consumed to pig iron product was the same in 1942. The British did not allow for any iron blast furnace charge except ore, since their pig iron estimate was 32 million tons of pig iron. The present estimate considers that about 85 percent of the blast furnace metal charge is from ore, the remainder comes from scrap sinter slag and pyrites. The relationship of ore and pig iron in 1937 was found for each

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country and applied individually.

8. This scrap estimate is larger than that of the British who estimate that "present scrap supply is 18-20 million tons per annum; between ten and twelve of this arise in steel works and rolling mills and the bulk of the remainder comes from outside engineering works and other consuming industries" (MEW, June 12, 1942 op.cit.). Actually, since 38 million tons of ingots and castings, 8 million tons of foundry products and 32 million tons of ore are estimated, then if steel plant loss (i.e. convertor loss and open hearth loss) is 10 percent as we have assumed, the British are forced to accept 18.5 as their actual total scrap figure. In the more recent study (July 27, 1942) of consumption, it was found that finished weight of steel was about 21 million whereas ingot requirements were over 39 million. This would mean that scrap from processing was over 16 million. In light of the production of war materials with high degree of fabrication, this seems much more reasonable. Old scrap furthermore probably would not be less in the present period due to battle-field scrap, bomb damaged facilities, etc. Thus, our estimate of total scrap is, if anything, too low, since the estimate of process scrap is based on a consumption on pattern of 39 million rather than a larger figure which would necessarily be carried if the scrap contribution is as large as 25

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million. Also pyrites, slag and sinter have been ignored, and they naturally contribute some metal. After the total scrap figure was arrived at, the problem of distributing between countries arose. Distribution patterns for ingots and castings and foundry products were obtained, and this necessary metal supply estimated for each country at a level for the Axis of 44 million. The difference between Axis metal supply for individual countries and their ore supply was taken to be the amount of scrap used.

9. Metal supply was obtained adding steel ingots and castings, steel plant loss, and foundry products for each country.

10. The British estimate for foundry products of 8 million (June 12, 1942 op.cit.) was accepted. It was distributed in accordance with the production of steel ingots and castings.

11. Metal supply minus foundry products.

12. This is the same as the steel plant loss used for 1937.

13. The total figure of 44 million for Axis Europe was arrived at by adding ore 32 million and scrap 25 million, plant loss 5 million. This total exceeds the British estimate by 6 million tons. The problem presented itself as to where this extra six million would be produced. Germany

was pressing on capacity, but it was believed that the French-Belgium situation actually was at a low level. Therefore, the 44 million was distributed in the same relative way the 38 million was formerly distributed by the British.

14. This assumes scrap pyrites, slag and sinter of about 28 million total.

15. Estimates based on MEW reports op. cit., and American Iron and Steel Institute figures.

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